



# The paradox of openness revisited: Collaborative innovation and patenting by UK innovators<sup>☆</sup>



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## ABSTRACT

We revisit the “paradox of openness” in the literature which consists of two conflicting views on the link between patenting and open innovation—the spillover prevention and the organizational openness views. We use the data from the Survey of Innovation and Patent Use and the Community Innovation Survey (CIS6) in the UK to assess the empirical support for the distinct predictions of these theories. We argue that both patenting and external sourcing (openness) are jointly-determined decisions made by firms. Their relationship is contingent upon whether the firms are technically superior to their rivals and lead in the market or not. Leading firms are more vulnerable to unintended knowledge spillovers during collaboration as compared to followers, and consequently, the increase in patenting due to openness is higher for leaders than for followers. We develop a simple framework that allows us to formally derive the empirical implications of this hypothesis and test it by estimating whether the reduced form relationship between patenting and collaboration is stronger for leaders than for followers.

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## 1. Introduction

Over the last quarter century two apparently contrasting trends have marked the innovation process. On the one hand, patents have become increasingly important as an appropriation tool (OECD, 2004; WIPO, 2007). On the other, innovators are increasingly relying upon collaboration with other firms and organizations (Chesbrough, 2003). The question we address in this paper is the relationship between sourcing knowledge from the outside to

develop innovations and using patents to appropriate the returns from innovation.<sup>1</sup>

The relationship between the reliance on external sources and the appropriability strategy of firms has been analysed extensively since the early paper by Cassiman and Veugelers (2002). This literature has converged around two conflicting points of view, which Laursen and Salter (2014) dub the “paradox of openness”, namely that opening up to outside sources of knowledge to innovate may weaken the firm’s power to capture rents from that knowledge. In other words, openness, or external sourcing, entails a trade-off. On the one hand, firms are more likely to seek external collaborators if they can protect their innovation by patents, and more generally, guard against unintended knowledge spillovers to partners. We call this the “*spillover prevention*” view. The second view, which we call “*organizational openness*”, holds that a focus on patenting and exclusivity makes a firm less efficient in developing collaborative innovations, and hence also, a less attractive partner.

Our paper advances the debate on openness versus patenting in several ways. First, we argue in this paper that the relationship

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<sup>1</sup> There is an older and even more extensive literature on the importance of patents for selling or licensing technology (Arrow, 1962; Arora et al., 2001; Gans et al., 2008). See also Arora and Gambardella (2010) for a survey of the literature.

between external sourcing (openness) and patenting is contingent. Firms will make different choices depending upon whether they are technically superior to their rivals and lead in the market or not. Put differently, the trade-off between appropriating benefits and enhancing the efficiency of collaboration differs between leaders and followers. Leading firms are more vulnerable to unintended knowledge spillovers during collaboration as compared to followers, and consequently, the increase in patenting due to openness is higher for leaders than for followers. We test this by estimating whether the reduced form relationship between patenting and collaboration is stronger for leaders than for followers.

Second, we advance the literature by treating both patenting and openness as choices made by the firm, and therefore, as jointly determined endogenous variables. The existing literature has treated either openness as logically prior to appropriability (e.g., Laursen and Salter, 2014) or appropriability as logically prior (e.g., Zobel et al., 2013). We develop a simple framework that provides a useful way to link the underlying theories based on the costs and benefits of collaborative innovation to the observed relationship between patenting and openness. Instead of interpreting our results as causal relationships, we treat them as describing the patterns of association between patenting and openness, and use our framework to infer what these patterns imply for various theories, and how this varies between leaders and followers.

Our third contribution is to introduce new and more precise measures of the use of patents based upon a new survey, instead of relying upon perceived importance of various appropriability strategies as much of the existing literature has done. Our data are based on a survey of over 800 UK firms using the sixth wave of the Community Innovation Survey (CIS 6). We are able to augment our data by also using the responses of these firms in the CIS 6.

The remainder of this paper is organised in the following way: Section 2 surveys the relevant literature on the paradox of openness and highlights the issues that limit the empirical analysis in this area. Section 3 articulates why leaders face a different trade-off from followers, and provides a simple model of the benefits and costs of openness that links the theoretical trade-off to behaviour, which motivates our empirical analysis. Section 4 introduces the data and describes our key measures. Section 5 discusses the empirical results. Section 6 concludes.

## 2. Openness and appropriability

### 2.1. Theoretical views

There are two dominant views on how patenting is related to use of external knowledge sources in innovation – we call these the “*spillover prevention*” theory and the “*organizational openness*” theory.

In the “*spillover prevention*” theory (Cassiman and Veugelers, 2002) firms engaged in outside collaboration favour the use of patents as a means of reducing spillovers of valuable knowledge to external partners. In the simplest version of the spillover theory, firms want to prevent imitation of their (focal) innovation and patent in order to protect the rents from that innovation. The likelihood of spillovers is greater if the firm is open i.e., if it collaborates with a partner, because collaboration inevitably reveals more information to others than if the innovation were entirely in-house.

It is widely recognized that using external knowledge could make it more difficult to protect the innovation. For instance, Noordhoff et al. (2011) argue that innovations sourced from customers carry the risk that the customer may implement the invention itself, in effect becoming a competitor. Giarratana and Mariani (2014) argue that using outside sources of knowledge makes it harder to enforce secrecy within the firm, increasing the

risk of imitation. Consequently, if a firm is unwilling to patent, or if patents are ineffective, it may choose to be closed. The key takeaway is that a firm has a greater incentive to patent if it is open than if it is closed. Simply put, in this view, we expect to see a positive association between patenting and openness.

Protecting the focal innovation is not the only source of positive association between patenting and openness. Many innovations are complex and require prior knowledge or background knowledge. Crucial bits of background information can leak out to partners during collaboration. Patents can protect against leakage of background material as well. Arora and Merces (2004) develop an analytical model in which the fear of knowledge spillovers may lead firms to internalize research even if internal research is less productive than external research, and the patents condition this trade-off. Using firm-level data from Germany, Buss and Peukert (2015) document a positive link between R&D outsourcing and intellectual property infringement, particularly for generic knowledge.

More broadly, scholars have argued that strong IPRs are often beneficial and potentially even necessary for open innovation (Arora and Gambardella, 1994; Chesbrough, 2003). Thus, Graham and Mowery (2006) suggest that “. . . IP protection creates a platform for the transfer of knowledge assets. . .” (p.185). Note that Arora and Gambardella (1994) and Graham and Mowery (2006) have focused on the importance of IP protection to the agent transferring knowledge rather than sourcing it, whereas this paper is focused on firms sourcing external knowledge.

A different source of positive association between patenting and openness is that open firms may patent to signal their innovative capabilities to other firms (Alexy et al., 2009; Hagedoorn and Ridder, 2012). For instance, Hagedoorn and Ridder (2012) surveyed 86 firms which are active in open innovation and found that nearly 90% of the firms regard patent as important method for signaling the nature of their technological capabilities.

In sum, firms that rely on external sources of knowledge (open firms) will patent much more than firms that do not (closed firms) for three reasons. First, they want to protect their focal innovation produced through collaboration; second, they want to protect the background knowledge implicit in the innovation; and third, they want to send out precise signals about their value as innovation partners.

By contrast, the “*organizational openness*” theory, inspired partly by studies of open-source software and the literature on “collective invention” (cf. Allen, 1983; Bessen and Nuvolari, 2012), implies that firms engaged in external collaboration should be less likely to use patents. Laursen and Salter (2014) note that a focus on patenting may make it harder to collaborate with outsiders. For instance, Foss et al. (2011) show that in order to benefit from customer interactions, firms have to delegate responsibility and increase internal communication. An unintended consequence may be that proprietary information can spill out. In other words, a focus on protecting the firm’s proprietary information is likely to make it more difficult to collaborate with outsiders. Other scholars have also stressed the tension between IPR and openness to outside knowledge. Jensen and Webster (2009) contend that knowledge capture practices may impede collaborative knowledge creation process. For example, interacting with other organizations to stimulate knowledge creation relies on interdependencies and reciprocities, whereas patenting gives rise to exclusivity. The emphasis on exclusivity that a patenting intensive appropriation strategy entails can impede the efficiency of collaborative development of innovation.

Interestingly, even those who believe that open innovation is often facilitated by strong intellectual property rights (IPR), concede that firms may benefit from voluntarily waiving some of their intellectual property rights (Chesbrough and Appleyard, 2007; Pisano, 2006). The strategy that firms choose to purposefully disclose selected knowledge to general public (including competitors),

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